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ABSTRACT

This conference paper suggests a promising model, based on a study of elementary school teachers in California, to investigate the relationship between the cognitive characteristics of teachers, their teaching behavior, and the academic success of their pupils. In the research model, two major components which affect student achievement were measured: (1) Teacher Knowledge (knowledge of subject being taught and knowledge of teaching); and (2) Teacher Aptitude (verbal, numerical, reasoning, memory, and kinds of divergent production aptitude). It is hypothesized that certain matches between teacher and pupil knowledge, skill, aptitude, and cognitive style tend to facilitate pupil learning. A preliminary factor analysis of the above components indicates that the Teacher Test Battery developed in conjunction with this research model was actually able to measure these structures. (CS)

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TEACHER APTITUDE AND COGNITIVE STYLE:

THEIR RELATION TO PUPIL PERFORMANCE

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Surprisingly little research has been done on the relationship between the cognitive characteristics of teachers, their teaching behavior, and the academic success of their pupils.

In his paper, Fred McDonald has presented a model of the many components of teacher behavior which affect student achievement. I'd like to focus my dicussion on two components of that model: (1) Teacher Knowledge, and (2) Teacher Aptitude.

Teacher Knowledge. In developing this model, two major components of teacher knowledge are hypothesized: (1) Knowledge of the subject being taught, and (2) Knowledge of teaching.

Knowledge of subject matter is a concept familiar to us all so I will not elaborate on it much here except to say that the relationship between teacher knowledge in a content area and pupil achievement in that same area may not necessarily be a positive one. For example, one study (Rouse, 1968) found a slightly negative correlation between the amount of college mathematics studied by elementary school teachers and the arithmetic achievement of their pupils.

The knowledge of teaching is a somewhat more complex concept. It involves, not only the techniques of classroom management but also the methods and materials which can be used in teaching a given subject. This concept

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also include the ability to know what methods and materials should be appliead to different students and when each is appropriate or inappropriate.

In a study of elementary school teachers in California, we have attempted to measure these components of teachers knowledge. Since this research was focused on the teaching of reading and mathematics, we were concerned about the teachers' own skills in these subjects. Consequently, we tested teachers' mathematics knowledge by asking them to do both simple arithmetic computations and also more complex mathematical problem solving. We measured reading skill by giving each teacher a test of decoding skills and in addition, a measure to assess a higher level comprehension skill, drawing inferences from reading. We assumed that a teacher who had trouble with a skill like letter-sound correspondence or drawing inferences would be less effective in teaching that skill than a teacher with more skill in these areas. This could be because the teacher is less able to communicate the essential knowledge to the pupil or, because the teacher spends less instructional time on areas in which he feels less competent, thereby providing the pupils less opportunity to learn. Classroom observation can provide us with evidence to determine the degree to which these actually occur.

In this study, we alsc administered tests of the teachers' knowledge of the teaching of reading and mathematics. The reading tests also included teachers' application of their knowledge of teaching reading to certain hypothetical situations. In addition we wanted to include a more realistic measure of skills related to the teaching of reading than any paper-and-pencil test could provide, so a film test was designed to assess teachers' skills in diagnosing pupil reading difficulties.

Teacher Aptitudes. The second major component of our model is Teacher Aptitude. In our study in California, we focused on five kinds of aptitudes relevant to teacher behavior. They are: (1) verbal, (2) numerical, (3) reasoning, (4) memory, and (5) the kinds of divergent production aptitudes sometimes called creativity but which are probably be better described as fluency and flexibility.

These aptitudes were selected after considering both the literature on cognitive factors presented in various models of the structure of intellect (Carroll, 1974; Guilford, 1967) and also the very limited amount of research which has been done on the relationship between teacher aptitudes and pupil achievement.

Verbal ability is the only teacher aptitude which has received much research attention. Most of this interest stems from the finding of the Coleman study (Equality of Educational Opportunity, 1966) which showed that teachers' verbal ability was one of the characteristics most consistently related to pupil achievement. This finding has been replicated by other researchers (e.g. Hanushek, 1970).

We do not know, however, why teacher verbal ability is imporant to pupil achievement. A number of reason have been suggested. These include hypotheses ranging from suggestions that verbal ability is simply a proxy for general intelligence to suggestions that teachers with higher verbal ability are more able to negotiate their way into schools where pupils overachieve for other reasons. It seems likely that the size of a teacher's vocabulary may be related to her success in communicating with students. However, this relationship may not be the same for all groups of students. For example, in working with Mexican-American children with a more limited knowledge of English, the larger teacher vocabulary may be a source of confusion rather than provided with multiple avenues to understanding.

Because we were interested in how our California Teachers compared with those in the Coleman study, we decided to measure verbal facility with the same test used in that study. This test asks the subject to select the best word to use in a blank in a sentence. But in our study we also included a vocabulary test which asked the subject to select a synonym for a stimulus word. As might anticipate, these two measures were fairly highly correlated (.54).

A factor analysis of our teacher test battery, which I will discuss in more detail later, suggests that the Coleman study test is more nearly a measure of verbal reasoning while the vocabulary test and some of the other tests which I will be describing in a few minutes, seem to be better indicators of verbal fluency. This difference in the nature of these measures may explain the earlier finding that teacher scores on the Coleman study verbal facility test tend to be more highly correlated with pupil achievement in mathematics than with achievement in reading. Our teacher test battery includes a number of other different measures of reasoning which we anticipate will also be related to pupil achievement in mathematics and possibly to higher order reading skills.

We will be interested to find out from our data analyses if the relationship between teacher verbal ability and pupil achievement is linear or curvilinear. Taylor (1967) has suggested that people with high verbal ability are able to communicate more ideas in a given period of time but it is possible to think of situations where the pacing of new ideas could be too rapid for some groups of pupils, especially if accompanied by unfamiliar vocabulary.

Divergent production seemed to represent another group of aptitudes which would be related to teaching skills. Of these fluency seemed especially important. Both associational and expressional fluency have been shown to be skills utilized when instructing others and, therefore, directly related to pupil achievement. However, individuals with very high or very low ideational fluency have been found to be less effective in transmitting information than those with ideational fluency in the middle range (Taylor, 1966). Another important divergent production aptitude is flexibility. (Actually, I am not sure whether flexibility should be considered as an aptitude or as a cognitive style.) Student teachers who are more flexible have been shown to be more effective in helping children to think for themselves (Hunt and Joyce, 1967). Good communicators are more flexible than poor communicators, but flexible individuals may by judged by others as performing in ways that are less efficient and less effective (Taylor, 1967). It has also been suggested that there may be systematic interaction between convergent and divergent teachers and convergent and divergent pupils (Hudson, 1968). We plan to investigate this and whether other matchs between teacher and pupil attitude patterns tend to facilitate pupil learning or systematically moderate teacher-pupil interaction.

Cognitive Style. Cognitive style has been shown to be an important variable in school performance (Witkin, 1973). It not only affects pupils' academic development at every educational level, but also is an important factor in understanding how students learn, how teachers teach, and the classroom interaction of teachers and students.

We know that people who choose elementary school teaching as a profession tend to be relatively field-dependent. We also know that the choice of teaching specialities is related to cognitive style. Thus, we would

expect to find more field-independent individuals specializing in the teaching of mathematics than in the teaching of reading. Preferred teaching strategy is also related to cognitive style. The more field-dependent teachers tend to use discovery or discussion methods while field-independent teachers tend to prefer lecturing (Wu, 1967). Again, classroom observations will permit a test of these hypotheses.

But perhaps the most interesting finding has been that, when teachers and pupils are matched for cognitive style, they describe each other more positively than do mismatched teachers and pupils. (Di Stefano, 1969). Witkin (1973) has hypothesized that people with matched cognitive styles may get along together better for three reasons: (1) shared foci of interest, (2) common personal characteristics, and (3) similarity of communication modes. The question remains as to whether this enhanced interpersonal perception has any consequences in terms of pupil achievement. Research (Thelen, 1967) which tried to group classes according to teachers' perception of the "teachability" of the students, showed that while students with high "teachability" scores got higher grades, than low "teachability" students, there were no differences in achievement test gains.

Factor Analyses. Now that you've heard these hypotheses about some of the kinds of teacher knowledge and teacher aptitudes which may affect pupil learning, you may be interested to know if our teacher test battery was actually able to measure these structures.

A preliminary factor analysis of most of the measures which I have discussed and some tests of teachers attitudes toward teaching suggests that this battery measures eight separate skills. I have tentatively identified these as: (1) analytic style, or the ability to approach a problem in a systematic way. This appears to be closely related to

cognitive style and seems to be better developed in those teachers who are most knowledgeable about teaching mathematics; (2) attitude toward teaching, (3) knowledge and skill differences related to the grade level taught; (4) a factor which seems to combine reasoning and the ability to cope with novel or unfamiliar material; (5) skill with well-practice material, such as mathematics computation; (6) memory; (7) verbal reasoning, which includes the Coleman study test and drawing inferences from reading; and (8) verbal fluency, which includes the vocabulary test and the divergent production measures of fluency.

This battery, which includes knowledge, skill, aptitude, attitude, and style components, seems a promising beginning to investigate the relationship of these teacher characteristics to teacher-pupil interaction and to pupil achievement.

Table 1

Teacher Test Battery

Test Statistics

Test	Title	Mean	Standard Deviation
701	Verbal Facility	25.06	3.33
702	Vocabulary	11.71	3.04
704	Root Words	44.87	0.53
705	Affixes	14.97	0.17
706	Syllabification	27.34	1.67
707	Inference	6.83	2.02
708	Reading Knowledge-Primary	4.60	0.80
710	Reading Knowledge-Intermediate	5.02	1.30
712	Memory	13.05	4.91
713	Picture Grouping	52.82	15.82
714	Nonsense Sayings	6.86	2.80
715	Induction	10.48	2.60
716	Mathematics Computation	32.26	7.60
717	Mathematics Aptitude	7.75	3.60
718	Math Teaching Knowledge	8.91	2.51
721	Finding Useful Parts	6.82	2.30
723	Embedded Figures	17.78	5.29
724	Sentence Completion	26.56	12.30
725	Topics	27.12	6.71
726	Story Surprises	3.48	2.18
727	Controlled Associations	39.76	16.28
728	Making Sentences	10.91	2.83
729	Listing Objects	25.33	6.10
730	Planning	7.21	2.06
731-1	Attitude-Teaching Reading	8.57	1.78
731-2	Attitude-Teaching Math	8.85	2.03

		01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17
701	Verbal Facility	--	54		20	11	18	69	21		43		24	29	22	41	20	44
702	Vocabulary	54	--		23	08	13	58	17		42		18	23	01	32	16	32
703	Decoding																	
704	Root Words	20	23		--	-04	15	28	17		20		09	17	-01	34	04	24
705	Affixes	11	08		-04	--	04	10	12		00		03	-10	-12	06	23	-03
706	Syllabification	18	13		15	04	--	22	-27		19		-14	06	03	16	06	08
707	Inference	69	58		28	10	22	--	27		45		26	42	17	54	24	46
708	Primary Knowledge	21	17		17	12	-27	27	--		00		25	11	01	15	01	12
709	Primary Application																	
710	Intermediate Knowledge	43	42		20	00	19	45	00		--		14	28	-04	39	-14	22
711	Intermediate Application																	
712	Memory	24	18		09	03	-14	26	25		14		--	23	03	28	10	30
713	Picture Grouping	29	23		17	-10	06	42	11		28		23	--	15	46	20	38
714	Nonsense Sayings	22	01		-01	-12	03	17	01		-04		03	15	--	19	23	31
715	Inductive Reasoning	41	32		34	06	15	54	15		39		28	46	19	--	22	45
716	Math Computation	20	16		04	23	06	24	01		-14		10	20	23	22	--	37
717	Math Application	44	32		24	-03	08	46	12		22		30	38	31	45	37	--
718	Teaching Math	40	35		19	02	20	51	-11		51		19	27	26	46	16	47
721	Useful Parts	54	40		38	12	08	52	25		39		33	31	07	45	15	35
723	Embedded Figures	46	41		42	00	15	55	09		47		29	43	01	61	23	54
724	Sentence Completion	43	20		33	-15	07	41	10		06		50	32	17	33	04	24
725	Topics (T)	27	37		37	-08	-11	26	25		12		11	17	09	22	22	36
726	Story Surprises	48	33		10	-04	12	47	02		12		26	34	18	44	15	56
727	Controlled Associations	30	45		35	07	01	44	20		36		22	22	04	42	30	36
728	Making Sentences	31	39		40	-03	15	47	-16		13		12	21	08	45	28	31
729	Listing Objects	19	21		41	-06	15	24	-04		09		19	26	10	41	29	22
730	Planning Test	44	33		41	02	12	58	25		32		15	25	11	46	10	37
731-1	Attitude - Reading	-06	-04		34	20	-09	-08	-08		-04		-19	-17	-17	-13	-12	-08
731-2	Attitude - Math	-07	06		28	08	-15	-07	06		-11		-05	04	-12	00	10	11

Teacher Test Intercorrelations

07	08	09	10	11	12	13	14	15	16	17	18	21	23	24	25	26	27	28	29	30	31-1	31-2
69	21		43		24	29	22	41	20	44	40	54	46	43	27	48	30	31	19	44	-06	-07
58	17		42		18	23	01	32	16	32	35	40	41	20	37	33	45	39	21	33	-04	06
28	17		20		09	17	-01	34	04	24	19	38	42	33	37	10	35	40	41	41	34	28
10	12		00		03	-10	-12	06	23	-03	02	12	00	-15	-08	-04	07	-03	-06	02	20	08
22	-27		19		-14	06	03	16	06	08	20	08	15	07	-11	12	01	15	15	12	-09	-15
--	27		45		26	42	17	54	24	46	51	52	55	41	26	47	44	47	24	58	-08	-07
27	--		00		25	11	01	15	01	12	-11	25	09	10	25	02	20	-16	-04	25	-08	06
45	00		--		14	28	-04	39	-14	22	51	39	47	06	12	12	36	13	09	32	-04	-11
26	25		14		--	23	03	28	10	30	19	33	29	50	11	26	22	12	19	15	-19	-05
42	11		28		23	--	15	46	20	38	27	31	43	32	17	34	22	21	26	25	-17	04
17	01		-04		03	15	--	19	23	31	26	07	01	17	09	18	04	08	10	11	-17	-12
54	15		39		28	46	19	--	22	45	46	45	61	33	22	44	42	45	41	46	-13	00
24	01		-14		10	20	23	22	--	37	16	15	23	04	22	15	30	28	29	10	-12	10
46	12		22		30	38	31	45	37	--	47	35	54	24	36	56	36	31	22	37	-08	11
51	-11		51		19	27	26	46	16	47	--	34	50	18	20	47	48	40	32	48	-05	10
52	25		39		33	31	07	45	15	35	34	--	52	43	26	34	34	30	19	45	-08	06
55	09		47		29	43	01	61	23	54	50	52	--	37	30	44	53	37	37	42	-05	12
41	10		06		50	32	17	33	04	24	18	43	37	--	04	30	27	19	31	29	-11	-10
26	25		12		11	17	09	22	22	36	20	26	30	04	--	24	31	46	36	19	18	22
47	02		12		26	34	18	44	15	56	47	34	44	30	24	--	28	46	26	38	-04	00
44	20		36		22	22	04	42	30	36	48	34	53	27	31	28	--	34	37	31	04	22
47	-16		13		12	21	08	45	28	31	40	30	37	19	46	46	34	--	36	49	09	17
24	-04		09		19	26	10	41	29	22	32	19	37	31	36	26	37	36	--	10	06	11
58	25		32		15	25	11	46	10	37	48	45	42	29	19	38	31	49	10	--	11	12
-08	-08		-04		-19	-17	-17	-13	-12	-08	-05	-08	-05	-11	18	-04	04	09	06	11	--	44
-07	06		-11		-05	04	-12	00	10	11	10	06	12	-10	22	00	22	17	11	12	44	--

Table 3

Teacher Test Battery -

Oblimin Factors (coefficient

Test		I	II	III	IV	V	VII	VII	VIII
701	Verbal Facility							.57	
702	Vocabulary	.33						.38	.51
704	Root Words		.48				.43		.38
705	Affixes					.86			
706	Syllabification			-.80					
707	Inference							.50	
708	Reading Knowledge (1-3)			.64				.41	
710	Reading Knowledge (4-6)	.85							
712	Memory			.31			.68		
713	Picture Grouping	.38					.32		
714	Nonsense Sayings				.72				
715	Induction	.41					.34		
716	Math Computation				.32	.67			
717	Math Aptitude	.30			.59				
718	Teaching Math	.66			.37				
721	Useful Parts						.41	.39	
723	Embedded Figures	.60					.31		
724	Sentence Completion						.89		
725	Topics								.84
726	Story Surprises				.60				
727	Controlled Associations	.52							.32
728	Making Sentences			-.32	.32				.41
729	Listing Objects						.40	-.40	.48
730	Planning		.35		.31			.54	
731-1	Attitude-Reading		.81						
731-2	Attitude-Math		.74						

I-Analytic Style
II-Attitude toward Teaching
III-? (Artifact of Level Taught?)
IV-Reasoning? (Ability to Cope with the Unfamiliar?)
V-Skill with
VI-Memory
VII-Verbal Reas
VIII-Fluency

Table 3

Teacher Test Battery - Total Group

Oblimin Factors (coefficients of .30 or higher)

V	VII	VII	VIII
		.57	
		.38	.51
	.43		.38
.86			
		.50	
		.41	
	.68		
	.32		
	.34		
.67			
	.41	.39	
	.31		
	.89		
			.84
			.32
			.41
	.40	-.40	.48
		.54	

Factor Correlations

	I	II	III	IV	V	VI	VII	VIII
I	-	.00	-.11	.23	.15	.31	.22	.27
II		-	-.04	-.04	.05	.01	.01	.18
III			-	-.09	.03	-.02	-.04	-.05
IV				-	.11	.24	.05	.21
V					-	.11	.07	.16
VI						-	.15	.27
VII							-	.10
VIII								-

V-Skill with Well-Practiced Material
VI-Memory
VII-Verbal Reasoning
nfamiliar?) VIII-Fluency

References

Carroll, J. B. Psychometric Tests as Cognitive Tasks: A New "Structure of Intellect." ETS RB-74-16, Educational Testing Service, 1974.

Coleman, J. S. et al. Equality of Educational Opportunity. Washington: Government Printing Office, 1966.

Di Stefano, J. J. Interpersonal perceptions of field-independent and field-dependent teachers and students. Unpublished doctoral dissertation, Cornell University, 1969.

Guilford, J. P. The Nature of Human Intelligence. New York: McGraw-Hill, 1967.

Hanushek, E. A. The Production of Education, Teacher Quality, and Efficiency. ERIC, 1970, ED 037 - 396.

Hudson, L. Frames of Mind: Ability, Perception, and Self-Perception in the Arts and Sciences. London, England: Methuen, 1968.

Hunt, D. E. and Joyce, B. R. Teacher trainee personality and initial teaching style. American Educational Research Journal, 1967, 4, 253-259.

Morsh, J. E., Burgess, G. G., and Smith, P. N. Student achievement as a measure of instructor effectiveness. San Antonio, Texas: Air Force Personnel and Training Research Center, 1955.

Ohnmacht, F. W. Factorial invariance of the teacher characteristics schedule and measures of two cognitive styles. Journal of Psychology, 1968, 69, 193-199.

Ohnmacht, F. W. Teacher characteristics and their relationship to some cognitive styles. Journal of Educational Research, 1967, 60, 201-204.

Rouse, W. M., Jr. A study of the correlation between the academic preparation of teachers of mathematics and the mathematics achievement of their students in kindergarten through grade eight. Doctoral dissertation, Michigan State University, 1968. University Microfilms No. 68-4205.

Taylor, C. W., Chiselin, B., and Yagi, K. Exploratory Research on Communications Abilities and Creative Abilities. Salt Lake City, Utah: University of Utah, 1967.

Thelen, H. A. Classroom Grouping for Teachability. New York: John Wiley, 1967.

Witkin, H. A. The Role of Cognitive Style in Academic Performance and in Teacher-Student Relations. RB-73-11, Educational Testing Service, 1973.

Wu, J. J. Cognitive style and task performance -- A study of student teachers. Doctoral dissertation, University of Minnesota, 1967. University Microfilms No. 68-7408.